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July 28, 1997

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554

Re: RM No. 9096

Dear Mr. Caton:

Transmitted herewith on behalf of Mark IV Industries, Ltd., I.V.H.S. Division, by its attorneys, are an original and nine copies of its Comments in the above-referenced proceeding.

If there are any questions or comments concerning this matter, please communicate with the undersigned.

Very truly yours,

George Y. Wheeler

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In re: Petition for Rulemaking of	)	
	)	
INTELLIGENT TRANSPORTATION SOCIETY OF AMERICA	)	RM No. 9096
	)	
Requesting an Allocation of 75 MHz of Spectrum in the 5.850-5.925 GHz Band for Use by Intelligent Transportation Systems	)	

To: The Commission

COMMENTS OF MARK IV INDUSTRIES, LTD., I.V.H.S. DIVISION

Mark IV Industries, Ltd., I.V.H.S. Division ("Mark IV") herewith, by its attorneys, files it comments in response to the Commission's Public Notice (DA 97-1106) dated May 28, 1997 regarding the above-referenced Petition for Rulemaking ("Petition") of the Intelligent Transportation Society of America ("ITS America").

MARK IV TECHNOLOGIES

Mark IV is a manufacturer of devices which are widely used by highway, toll, turnpike, tunnel and bridge authorities in intelligent transportation ("ITS") systems. Mark IV systems are designed to operate in conformance with existing Commission rules pertaining to LMS services in the 902-928 MHz band. These systems employ active and semi-active microwave, short range two-way communication technology consisting of three basic components: a vehicle mounted transponder, an antenna, and a roadside reader. The method of operation is straightforward -- the transponder, an FCC type accepted device, transmits its identification and other stored data to the antenna in response to a trigger pulse from the roadside reader, the Part 90 device. The antenna relays this information to the roadside reader which can store it and/or send it to a central computer.

The roadside reader can in turn transmit reprogramming data to the transponder. Transponders can be mounted on the underside of vehicles, elsewhere on the vehicle exterior, or inside of windshields.

The Mark IV system operates with reading/writing speed of 500 Kbits/second to support the high data rates necessary to implement advanced features while maintaining maximum system performance levels. Its systems are electronically robust incorporating low average power, spectrum spreading from use of short high speed pulses and minimal transmission path length operations. The coverage of Mark IV's distributed antenna system is highly localized because of the low transmitter power and because of antenna orientation. Using high data rate active and semi-active technology with time multiplexing, technologies employed in Mark IV devices are capable of operation in an unlimited number of highway lanes (or other types of detection points) with a single 6 MHz channel.

DEPLOYMENT OF SHORT-RANGE 902-928 MHz LMS SYSTEMS

Since the adoption by the Commission of LMS Report and Order,[1] the implementation of short-range LMS systems has grown substantially so that today most major U.S. toll highway, tunnel and bridges systems and many non-U.S. systems have short-range 902-928 MHz LMS systems or are planning to implement such systems in the near future.[2] The public benefits from electronic toll collection and related traffic monitoring capabilities cited by ITS America (ITS America Petition, pp. 13-14 and Appendix H, pp. 10 and 12) are already being achieved.

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[1] In the Matter of Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, Report and Order, PR Dkt. No. 93-61, 10 FCC Rcd. 4695 (1995).

[2] See ITS America's web site, "ETTM On The Web," (www.ettm.com) for "United States Toll Facilities," "US ETC Systems in Production/Development," and "Non-US ETC Systems in Production/Development."

Approximately 1.5 million vehicles currently use the Mark IV 902-928 MHz technologies and that this number will increase to over 2.0 million by the end of 1997. A major example of a system serving many of these vehicles is the "E-Z Pass[SM]" system, which uses Mark IV technologies in fully compatible electronic toll collection and traffic monitoring systems designed to serve the Garden State Parkway, the New Jersey Turnpike, the New York State Thruway, the Pennsylvania Turnpike, the Port Authority of New York and New Jersey facilities, the Atlantic City Expressway, the Tri-borough Bridge and Tunnel facilities, the Delaware Turnpike, the Delaware River Bridge , the John F. Kennedy Toll Road, the Baltimore Harbor Tunnel, the McKinley Tunnel and the Chesapeake Bay Bridge among other significant toll facilities in the Northeast.

Other toll systems which use Mark IV technologies in the 902-928 MHz band include the Dulles Toll Road, the Greenway Toll Road and the Coleman Bridge in Virginia and the Orlando-Orange County Expressway and the Dade County Causeway in Florida. The Illinois Tollway also will be using Mark IV technologies.

In addition, Mark IV and Hughes Transportation Management Systems, Inc. are currently manufacturing, and supplying compatible short-range LMS products for operation in the 902-928 MHz band which make use of active or semi-active technology for electronic toll collection and commercial vehicle monitoring systems.

RECOMMENDATIONS

The ITS America Petition presents far ranging technical and service proposals involving for the most part developmental applications of 5.8-5.9 GHz technologies. Particularly in the area of what ITS America characterizes as "Emerging" or "Future" DSRC-band services, its proposals include potentially innovative new services but little detail about service parameters, demand studies, projected costs, deployment options, technology choices and standardization efforts. Its Petition is a preliminary step in a process which will require detailed analytical review involving users, manufacturers and other interested parties. In these circumstances Mark IV makes the following recommendations:

- The Commission should commence broad-ranging inquiry proceedings[3] to review the diverse and complex allocations, licensing and service issues presented in ITS America's proposals.

- The Commission should recognize the legitimate expectations of the numerous incumbent licensees deploying systems in the 902-928 MHz band and the millions of vehicle owners who rely upon those systems to continue use of their authorized systems as long as they deem useful. They are entitled to reasonable assurances that their right to select new or improved technologies to meet their needs as they see fit in any authorized LMS frequency band will not be abridged .

- The Commission should also confirm for the benefit of manufacturers and other system developers that it does not intend to foreclose the use of frequency bands other than the 5.8-5.9 GHz band for the deployment of ITS services.

DISCUSSION

1. The Commission Should Confirm the Legitimate Expectations of All Incumbent LMS Licensees to Retain the Benefits of Their Long-Term Investments in LMS Infrastructure and of Continuity of Essential Public Services Provided Over LMS Systems.

The Commission should recognize the vast scope of public resources already devoted to the implementation of the existing and planned infrastructures to support electronic toll collection and traffic monitoring on 902-928 MHz LMS systems and the widespread public reliance on these essential systems. This is a long-term investment of public resources affecting millions of highway users. The Commission should confirm the legitimate expectations of the toll collection system and other ITS licensees to continue to operate their 902-928 MHz technologies for as long as they deem

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[3] See Section 1.430 of the Commission's rules.

appropriate to meet their responsibilities to the traveling public.

The policy guidance articulated, with approval by Chairman Hundt,[4] in the FCC staff report by Gregory Rosston and Jeffrey Steinberg, "Using Market-Based Spectrum Policy to Promote the Public Interest," released in January, 1997 is fully applicable here:

> "...[T]he Commission should exercise its jurisdiction to reallocate spectrum and change the rules governing use of spectrum with due regard for the reasonable expectations of incumbent licensees. No incumbent has a legitimate expectation of freedom from competition, but incumbents do expect that they will be able to continue using spectrum that they have been assigned without additional or unexpected interference, or major new service and technical restrictions."

The public benefits of providing such "certainty" to the licensees of electronic toll collection systems like the members of the Interagency Group are self-evident. The operation of such systems affecting millions of users daily is ultimately the responsibility of the numerous toll authorities who hold licenses for 902-928 MHz LMS systems. The Commission should confirm that their right to continue to operate their authorized systems is indisputable and not an issue in these proceedings.

2. The Commission Should Preserve the Rights of Toll Authorities and Other ITS Users to <u>Make Spectrum Choices</u>.

One of the Commission's primary goals in these proceedings should be to avoid adoption of allocations or licensing decisions which foreclose opportunities of toll authorities and other ITS users to make suitable spectrum/technology choices. Toll authorities and all other ITS users should be assured of their full rights to choose whatever available frequency band they deem appropriate.

The Commission's pro-competitive spectrum policies have stimulated technological

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[4] Statement of Reed E. Hundt on Spectrum Management Policy before the Subcommittee on Telecommunications, Trade and Consumer Protection, Committee on Commerce, U.S. House of Representatives, dated February 12, 1997.

innovation, spectrum efficiency, enhanced service quality/diversity and competitive pricing. The success of these policies should guide the Commission's determinations here so that toll authorities and other ITS users are not foreclosed from obtaining the maximum benefits from competition among equipment suppliers.

The value of preserving user options to make spectrum/technology choices is particularly apparent given the rapid pace of technological innovation and of the difficulties of predicting demand. The FCC staff report referenced above observes:

> "Given the rapid evolution of technology...the Commission cannot reliably predict what services will be available or which frequency range will be efficient for any service even a few years from now, much less what the public demand for each service will be and how to respond to changing demand."

The toll authorities and other users of ITS spectrum are uniquely positioned to make decisions regarding such matters. Their ability to choose bands other than 5.8 GHz must be protected because of their important public responsibilities.

3. The Proposed Use of the 5.8 GHz Band Presents Serious Technical/Cost Disadvantages for <u>Electronic Toll Collection Uses</u>.

Mark IV disagrees with the comparative analysis of 902-928 MHz and of 5.8-5.9 GHz technologies in the ITS America Petition (Appendix H, pp. 65-77). Attached is a brief analysis which outlines the serious technical and cost disadvantages which arise if technologies developed for use in the 5.8-5.9 GHz band are used for electronic toll collection systems. See Attachment A hereto.[5]

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[5] The attached analysis does not evaluate the potential for implementation of what ITS America has characterized as "Emerging" and "Future" DSRC-based services.

CONCLUSION

The ITS America proposals which it characterizes as "Emerging" and "Future" DSRC-based services deserve serious consideration because they involve potentially useful expansions of spectrum options for new and innovative services. In other areas such as electronic toll collection, traffic monitoring and commercial vehicle monitoring, where there is already a very large and expanding infrastructure base, its proposals do not adequately protect the rights of incumbent ITS system users. Its technical/cost assumptions for implementing these services at 5.8-5.9 GHz also fail to identify substantial problems which could effectively preclude massive redeployment to that band. The Commission's goal in these proceedings should be to preserve development opportunities for these "Emerging" and "Future" DSRC-based services at 5.8-5.9 GHz without impairing or foreclosing the deployment of established and emerging technologies for ITS uses in other frequency bands including the 902-928 MHz band.

Respectfully submitted,

MARK IV INDUSTRIES, LTD. I.V.H.S. DIVISION

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July 28, 1997

RISK ANALYSIS OF USING 5.8 GHz BAND FOR VEHICLE-TO-ROADSIDE COMMUNICATIONS

1. Introduction

This technical note provides a risk analysis for the use of 5.8 GHz band for vehicle-to-roadside communications (VRC). In particular, dedicated short range communications (DSRC) applied to electronic toll collection (ETC) system will be of the main concern. The following system performance parameters will be analyzed:

1. Path loss
2. Multi-path effect
3. Noise Immunity
4. Size/Cost

2. Path Loss

Path loss is proportional to signal frequency squared. At 5.8 GHz the propagation path loss increases by 20xlog(5800/915)=**16 dB** relative to the loss at 915 MHz. This extra loss must be compensated by the use of higher TX power and/or higher RX sensitivity for both roadside Reader and/or on-board Transponder.

3. Multi-Path Effect

Mutipath nulls due to surface reflection is more critical at 5.8 GHz than at 915 MHz. For a typical Roadside antenna mounted at 15 feet high and Transponder antenna at 4 ft high (transponder mounted on the passenger vehicle windshield), propagation loss for 5.8 GHz and 915 MHz signals is shown in Figure 1. As compared to 915 MHz, multipath nulls for 5.8 GHz is 5-6 times more due to shorter wavelength at higher frequency. Figures 2 and 3 show typical radiation patterns on the roadway using antennas for lane-based and wide area operations. At 5.8 GHz, within 10 ft of lane-based operation, there are 2 multipath nulls as compared to no null at 915 MHz. For wide area operation, there are 10 multipath nulls within 100 ft of coverage for 5.8 GHz as compared to only one null for 915 MHz. This means that RF data communications between Reader and Transponder will be more corrupted by multiple deep nulls within communication zone at 5.8 GHz as compared to 915 MHz signal. Higher TX power and/or higher RX sensitivity of both Reader and Transponder can be used to minimize multipath null degradation; however, this will result in more burden on the equipment design, cost, noise immunity and regulation compliance status.

4. Noise Immunity

As indicated in sections 2 and 3, to compensate for multipath nulls and higher path loss at 5.8 GHz higher TX power and/or higher RX sensitivity are required for both Reader and/or Transponder. Increase of the Transponder TX power will lead to higher power consumption, and as a consequence, this will reduce significantly lifetime of the on-board battery. Increase of the Reader TX power is constrained by FCC rules on radiated power density requirements for the AVI equipment. Thus, increase of RX sensitivity is the only feasible solution. In order to obtain the same performance margin as the 915 MHz (including higher coax cable loss at 5.8 GHz), an increase of 30 dB in RX sensitivity is required for both Reader and Transponder. This will result in –95 dBm sensitivity for the Reader and –60 dBm for the Transponder. With the assumption that antenna gain and operation bandwidth are unchanged, equipment design at 5.8 GHz is a challenging task since the equipment is more vulnerable to system noise, in-band and out-of-band interference. Component availability for commercial application at 5.8 GHz presents another challenge for the design process to achieve the system performance and noise immunity levels at 915 MHz.

5. Size/Cost

At 5.8 GHz, RF equipment such as overhead antenna and transponder size will be smaller as compared to that at 915 MHz. However, cost of RF components such as filters, mixers, amplifiers, etc... used for the design of RF module and transponder will increase tremendously. It is estimated that the cost of these modules will increase by a factor of 3-4 times as compared to those at 915 MHz. Higher cost associated with low loss coax cable at 5.8 GHz will also push up the total cost of the AVI equipment about the same factor. In addition, component technology especially GaAs, at 5.8 GHz for low power wireless communications is quite immature, which imposes further risk for selecting 5.8 GHz frequency range as ITS standard for DSRC application.

Figure 1. PROPAGATION LOSS COMPARISON
READER ANTENNA AT 15 FT, TRANSPONDER ANTENNA AT 4 FT

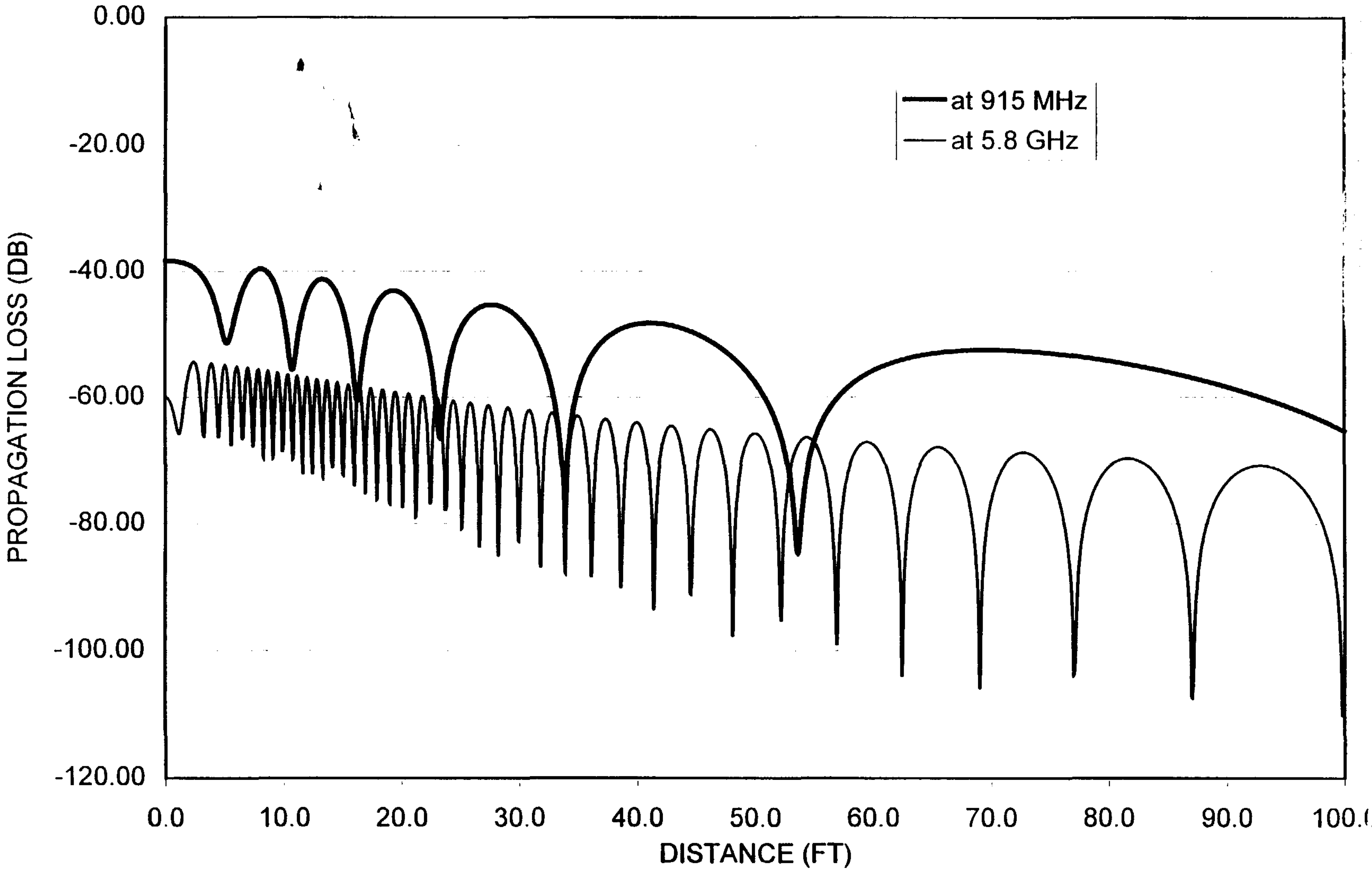

Figure 2. LANE BASED PERFORMANCE

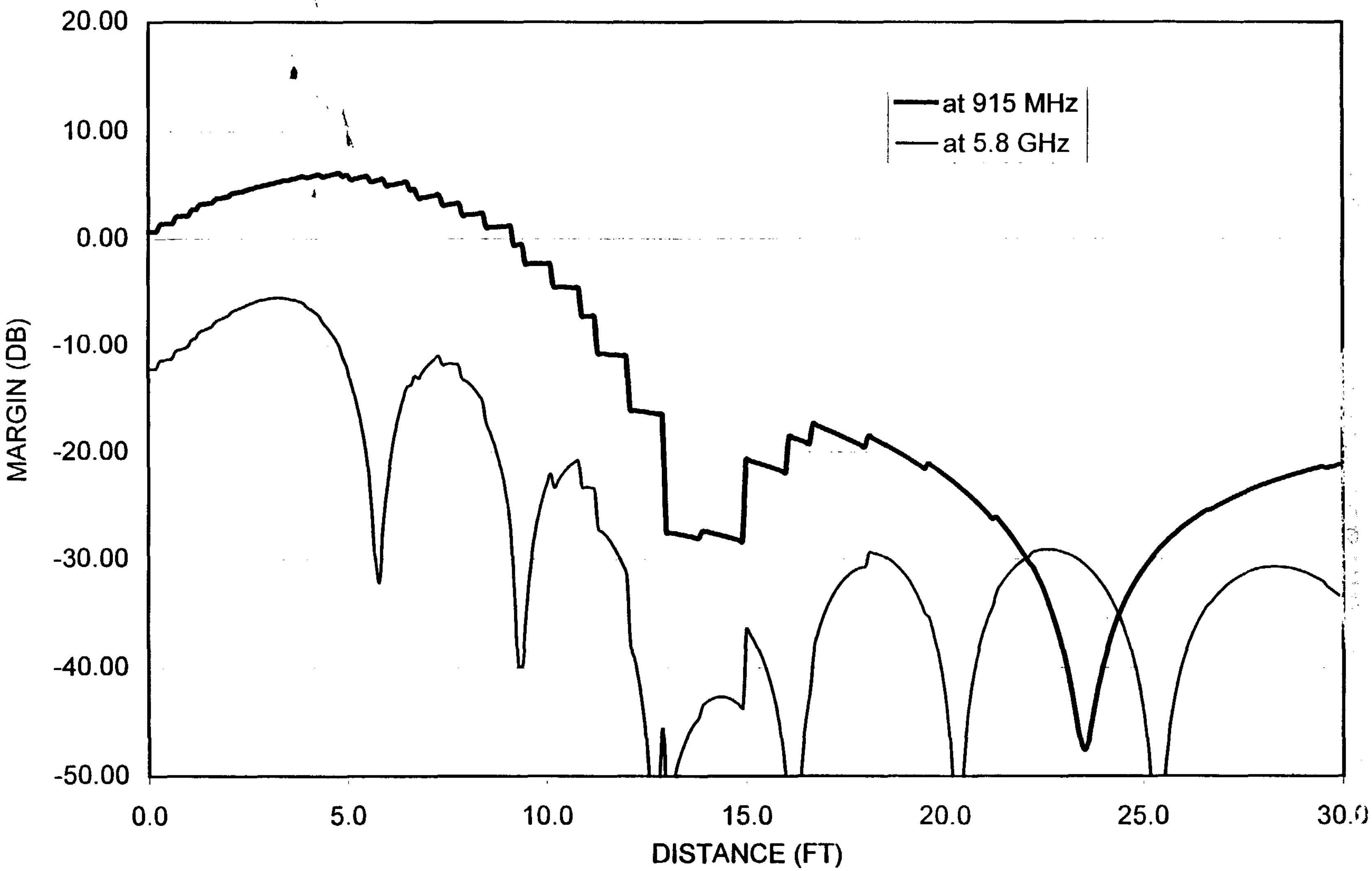

Figure 3. WIDE AREA PERFORMANCE